



Southeast Recycling Development Council **Characterization of Tennessee's Recycling Economy** **January, 2013**

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Report



Resource Recycling Systems
Sustainable Systems for a Waste-Free Future



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Characterization of Tennessee's Recycling Economy Tennessee Department of Environment and Conservation

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EXECUTIVE SUMMARY

The Southeast Recycling Development Council (SERDC) is assisting the Tennessee Department of Environment and Conservation (TDEC) in a characterization of Tennessee's current recycling economy, material flow, and potential opportunities that could increase local government collection of key recyclable materials. SERDC is working with TDEC specifically on the following strategic and implementation concepts.



➤ Lifecycle of Materials in Tennessee's Recycling Economy

• **Disposal Rates for Recyclables**

- Tennessee's state disposal and recycling data, together with waste composition data from multiple states and municipalities across the country, were used to develop a data set on a county-by-county basis for Tennessee. The goal for the information gathered was to determine the total tonnage disposed for five focus materials – paper, plastics, aluminum, steel, and glass (focus materials) – in the residential waste stream for each county in Tennessee.
- Total waste disposal in Tennessee in 2011 was approximately 7.2 million tons. Residential disposal is taken as a percentage of total waste disposed in the state. Using estimates from county annual solid waste reports and other data, SERDC determined that statewide disposal from the residential sector was approximately 3.3 million tons. This represents about 46% of total disposal. The focus materials in the disposed residential waste stream total just over 1.1 million tons.

• **Processing Infrastructure**

- Tennessee has a dependable network of Material Recovery Facilities (MRFs) and baling operations across the state. There is especially good development of MRFs in the population centers across Tennessee. There is a great opportunity for the residential sector to drive growth in the recycling economy through increased diversion throughout this network. There is also opportunity to feed into the MRF infrastructure through a hub-and-spoke approach in more rural areas of the state.
- An increase in the diversion of material for use in the Tennessee recycling economy will drive the investment in additional MRF capacity, either through expansion of existing facilities or the development of new infrastructure.
- With access to this infrastructure, communities can more realistically look to roll carts and single-stream collection as a core to their recycling services. Local governments can focus their investment on collection and education, and private sector firms or larger municipalities through partnerships can invest in the processing infrastructure needed to generate commodity grade products.

• **Local Recycling End Markets**

- Industries in Tennessee help drive the regional recycling economy. Material flows from communities to recycling facilities and then to various end users. Some of this material may leave Tennessee before being converted to a form for industrial use, then return to Tennessee to be consumed by a mill or manufacturer. Strong markets exist across the state for plastic, paper, aluminum, and steel.
- At each of the stops along the way, value is added. A secondary plastics processor might turn baled PET bottles into clean PET pellets (called repro in the plastics industry). The plastics processor will



buy the material from a MRF at the market rate for baled PET bottles, maybe \$.20/lb. After they grind, clean and pelletize the PET, they can then sell it to a blow molder or yarn manufacturer for around \$.70/lb depending on the market. The PET flake or pellet can then be consumed for many uses. One use is conversion to a polyester staple fiber with the value pushing up into the range of \$.90 to \$1.40/lb. These increased margins along the way are what create the value in the recyclable material that is collected at curbside. This is also what drives the recycling economy and creates feedstock for end users.

- SERDC has provided three end-user profiles to showcase the volume, type, and value of the material consumed and required by various industries in Tennessee, from the production of aluminum cans and cardboard boxes to raw materials for the auto industry. One sample profile can be seen below:

VICAM (PART OF VIAM MANUFACTURING)			
Location Data	Material Consumed	Value Add	Municipal Recovery Input
VICAM (part of VIAM Manufacturing) Manchester, TN Employees: 70	Type: PET (#1 plastic) bottles Amount: Capacity of 5,475 tons/year Distance range for sourcing supply: AL, SC, Japan	Purchase price: Clean, clear PET bottle resin (flake or pellet) market price, currently \$.70 - \$.89/lb Product manufactured: PET Staple Fiber Product value: Current market value range = \$2 to \$3/kg, or \$0.90 to \$1.36/lb	Annual municipal recovery in TN of PET bottles: 3,800 tons (estimated)
End User Notes: VICAM's new Manchester facility produces polyethylene terephthalate (PET) staple carpet fiber by recycling PET clear bottles, using Oyama Chemical's fiber technology. The carpet fiber will then be used in headliner, seat backs and door panels in the automotive industry.			

➤ Local Access to Recycling Markets

• Value of Focus Material in Disposed Waste Stream

- The disposal data produced by SERDC is used with recycling market commodity prices to develop an estimate of the value for the focus materials currently disposed in the residential waste stream.
- Annual residential disposal of 3.3 million tons was converted to pounds. This equals 6.6 billion lbs/year of residential disposal. Focus material was taken as a percent of total residential disposal. The pricing data was calculated using \$/lb averages for 2012, and totals about \$180.3 million for all the focus material in the residential portion of the waste stream.
- The market value calculation is designed to illustrate part of the economic impact due to the recovery of these materials. As these commodities move up the value chain, their market price grows as value is added. Depending on the material the multiplier can vary. This is the margin that creates the recycling economy, and provides the backbone for a green supply chain in the manufacturing of goods.



- **Community Profiles**

- Material in the residential waste stream is generated in communities across Tennessee. From urban centers like Nashville and Memphis, to suburban and rural communities like East Ridge and Lewisburg.
- Each of these communities plays a role in the recovery of material that drives the recycling economy in Tennessee. The infrastructure available in each community may vary, but the integration of all these players is what pushes the flow of recovered material. This creates the economic engine called recycling that drives the supply chain, and feeds industry across Tennessee and the Southeast.
- SERDC has developed community profiles for a diverse collection of municipal and county recycling programs. These profiles are not meant to showcase “model” programs, but to discuss various methods used for residential recovery, and highlight options to divert more material and grow the recycling economy in Tennessee. See a sample below:

CITY OF EAST RIDGE (SUBURBAN, CURBSIDE)			
Location Data	Service Scenario Highlights	Diversion & Disposal (Residential)	Options for Increased Recovery
City of East Ridge Population: 21,259 # of Households: 9,996 # of HH's with access to carts in 2012: 1,791	Type of collection: Curbside w/95-gallon roll carts Frequency: Every other week Facility used: RockTenn Distance to recycling facility: Chattanooga, 7 miles	TPY collected: 395 Pounds per household collected: 79 (441 lbs/household based on number of households with access to carts in 2012) Residential disposal (tons): 15,367 Focus materials in residential disposal (tons): 5,503	✓ Focus area = Access ✓ East Ridge should invest in the carts and collection infrastructure needed to offer curbside recycling service to all the households in the city. If the city as a whole recycles at the same lbs/household rate as those that currently have curbside access, then East Ridge could see an increase of over 1,800 tons per year of diversion.
Materials accepted: All paper and boxes (including cartons and paperback books), all plastic bottles and containers (including tubs, lids, and plastic trays), all metal and aluminum cans, glass bottles and jars, and plastic bags. See their flyer.			

- **Targeted Areas of Investment**

- MRF access near population centers will create the infrastructure to grow diversion and push material into the recycling economy. Across the state, local communities have varied programs

TARGETED AREAS OF SUPPLY IMPACT			
Targeted Locations	TN Counties Touching 50-mile Driving Radius	# of Households	Additional Supply Available (tons)*
Chattanooga, Kingsport, Knoxville, Memphis, Nashville	67 counties	2,391,890	483,140

*based on the recovery of 50% of the focus material in the residential waste stream



collecting a range of different materials. Some include glass; others do not. Some collect all plastic; others just plastic bottles. A growing number of communities have moved to single-stream programs, others still source separate. Some single-stream programs accept cartons (gable-top containers and juice/wine/soup boxes) – which are a growing portion of the waste stream – and others do not. These are just a few examples of the variation in collection programs.

- Moving toward a processing model that involves a network of single-stream MRFs is one strategy to drive more diversion. At this time, only 44 cities and towns in 26 counties collect recycling through curbside recycling programs, and only 38 of those collect material commingled. The remaining counties and municipalities rely on varied programs designed around convenience sites and recycling drop-off locations.
- Integration across Tennessee will help to broaden the list of materials collected, drive more diversion, and create the critical mass to grow the recycling economy.
- Increased diversion from residential recycling programs could drive economic growth from this sector.
- The economic growth will come from the market value of recovered material, investment in collection and processing infrastructure, job growth, efficiencies in transport and collection, and decreased disposal costs for local government. See the chart to the right for details on the high level economic impact per 10,000 tons of additional diversion.

ECONOMIC DEVELOPMENT IMPACT PER 10,000 TONS OF ADDITIONAL DIVERSION (SINGLE-STREAM MATERIAL)	
Capital Investment	
Collection Trucks	\$281,250
Carts	\$500,000
MRF Infrastructure	<u>\$400,000</u>
	\$1,181,250
Market Efficiencies	
Avoided Disposal	\$350,000
Material Value	<u>\$1,510,200</u>
	\$1,860,200
Job Growth	
Material Collection	10
MRF Operations	10
Plastic Manufacturing	9
Glass Manufacturing	4
Paper Mills	10
Recycling-Based Manufacturers	<u>25</u>
	68

➤ Conclusions

• Opportunity

- Access is a driver that can impact diversion. Access married with education, outreach, and incentive programs around recycling will impact diversion for the long term. Long-term diversion performance will drive economic development around materials management. Increased recycling directly leads to economic development from new jobs and capital investments. While local in scale, these drivers function as utility-based operations that scale up as the regions expands access.
- Investment will occur at the local level around collection infrastructure. Investment will occur in the private sector around primary and secondary processing, and with industrial development around product specific manufacturing to feed regional industrial material needs.



- Value will be generated as material moves from generation to collection, processing, and end markets. The value added at each step along the way is what will drive the recycling economy. The more volume available, the larger the economic impact of material diversion.
- Jobs are created as access drives diversion, investment, and value. The higher material moves along the value chain, the greater the impact around job creation.

- **Evaluations**

- The State of Tennessee is well positioned to take advantage of its infrastructure to drive access and economic development. The State understands the investments needed on the local level for successful diversion. There needs to be an effort focused around integration of the existing infrastructure to push recovered material into the marketplace.
- The road map for integration can be developed through the solid waste planning process. The State of Tennessee is in the early stage of developing a state-wide solid waste management plan.
- Sustainable materials management and integration of recycling and investments in recycling will be an important piece of this planning. Integration will involve input from the public and private sector, as well as investment planning on the part of municipalities, industry, and public/private partnerships.





LIFECYCLE OF MATERIAL IN TENNESSEE'S RECYCLING ECONOMY

The State of Tennessee is taking steps to learn more about the collection and processing infrastructure that feeds the recycling economy. This process will better position state and local governments to take advantage of the economic benefits of recycling.

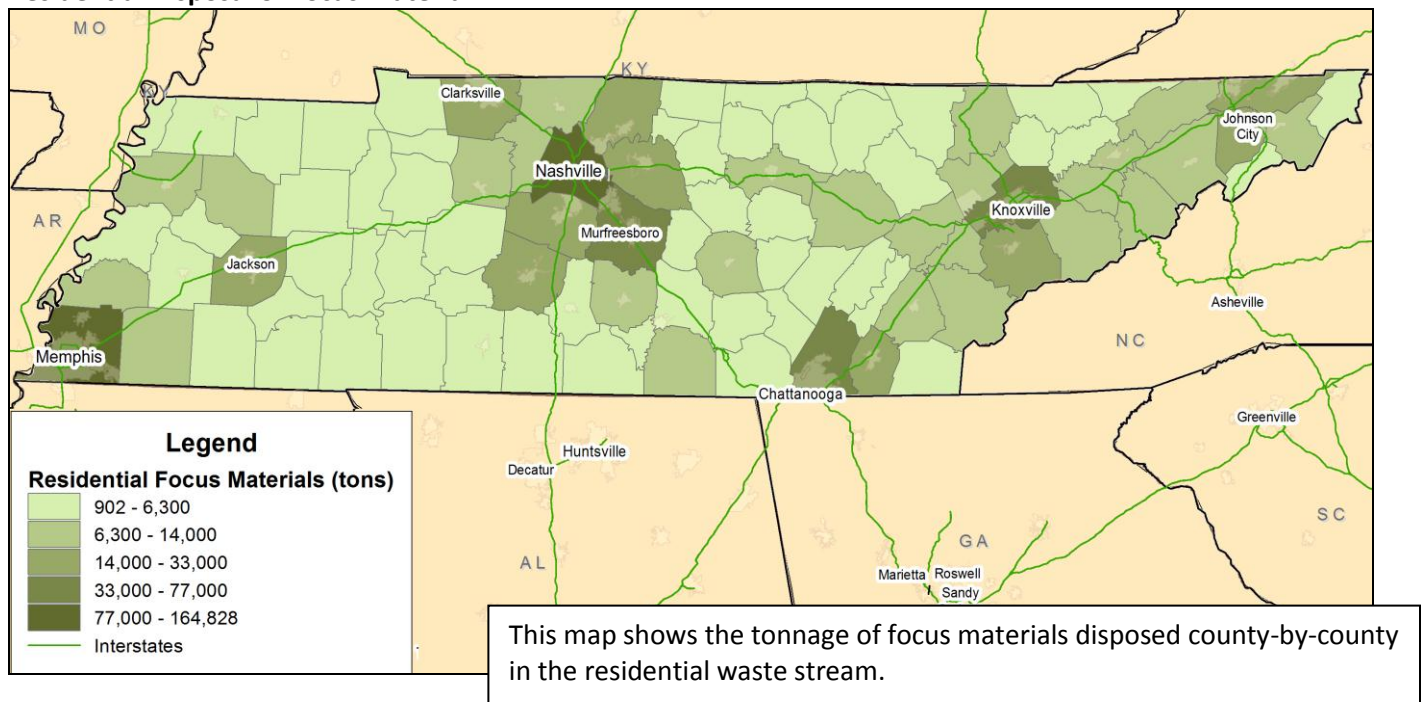
From generation to commodity feedstock for industry, recycling is a cost-effective avenue for growth in the manufacturing supply chain. The role of recycling as an economic driver is still in its infancy. The investment in this sustainable utility is one key to regional economic growth. A healthy recycling economy is an indicator of robust economic development.

DISPOSAL RATES AND RECOVERY OPPORTUNITIES

Tennessee's state disposal and recycling data, together with waste composition data from multiple states and municipalities across the country, were used to develop a data set on a county-by-county basis for Tennessee. The goal for the information gathered was to determine the total tonnage disposed for five focus materials – paper, plastics, aluminum, steel, and glass (focus materials) – in the residential and commercial waste stream for each county in Tennessee.

Information from the waste composition studies provided estimates for the percent composition of the focus materials in the waste stream. The disposal data was modeled against county residential and commercial census data to arrive at an annual number for disposed tonnage for the five focus materials.

Residential Disposal of Focus Material:



FOCUS MATERIAL IN RESIDENTIAL WASTE STREAM

SERDC has developed maps that illustrate annual disposal for the focus materials based on total tonnage¹. The map above illustrates the range for annual disposal of residential focus material. Separate mapping data was developed for the disposal of commercial focus material as well as a combination of the two. These additional maps can be found in Appendix II.

There is more waste disposal in higher population areas. What should be noted from this map is the material available for diversion. There is an opportunity in the population centers across Tennessee for a relatively dense availability of resources. This does not mean there isn't opportunity in rural communities, just that we have a critical mass and opportunity for recovery that we need to build our economy around in the urban and suburban areas. Rural areas are very well positioned to operate a hub-and-spoke² collection infrastructure that can feed into the recovery systems that are developed in the population centers around Tennessee.

TENNESSEE PROCESSING INFRASTRUCTURE

Tennessee has a dependable network of Material Recovery Facilities (MRFs) and baling operations across the state. There is especially good development of MRFs in the population centers across Tennessee. There is a great opportunity for the residential sector to drive growth in the recycling economy through increased diversion throughout this network. There is also opportunity to feed into the MRF infrastructure through a hub-and-spoke approach in more rural areas of the state. An increase in the diversion of material for use in the Tennessee recycling economy will drive the investment in additional MRF capacity, either through expansion of existing facilities or the development of new infrastructure.

MATERIAL RECOVERY FACILITIES – PUBLIC AND PRIVATE

The national trend for recovery of recyclable materials has increasingly switched away from source-separated collection (different bins for different types of materials) to single-stream collection (mixed recyclables in one container). This switch facilitates ease of use for the person recycling the item and offers communities the chance to enhance collection efficiency, as the cost for collection decreases. Material Recovery Facilities (MRFs) accept this mixed material and use a series of automated and manual processing to sort the blended recyclables into streams of single material types. These materials are then baled and marketed to other recyclers, secondary processors and manufacturers for application in new consumer goods.

The breakdown and range of recycling facilities in Tennessee³:

¹ Total disposed tonnage determined from Re-Trac data through county solid waste reporting provided by TDEC. Percent composition of focus material provided using [State of Georgia Waste Composition Study](#), 2008. Residential portion of disposed waste stream determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

² See Appendix I, for a glossary of terms.

³ Recycling facility list developed using TDEC facility data as well as SERDC and RRS MRF data. The facility capabilities were determined through conversations with TDEC staff, as well as through direct phone conversations with public and private recycling facilities. For a detailed list of each facility highlighted on the Recycling Processing Facilities Map, see Appendix II.

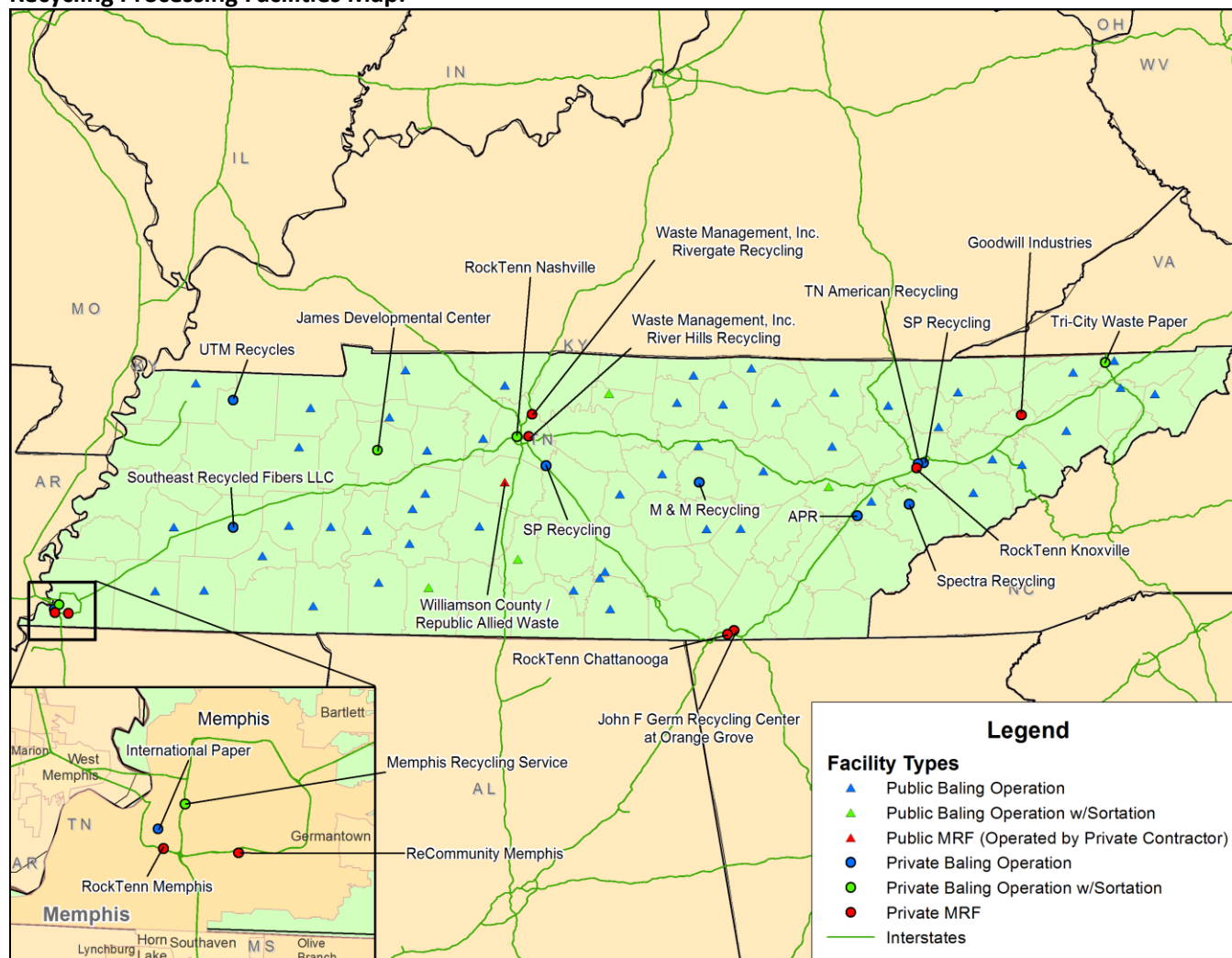


RECYCLING FACILITY BREAKDOWN

Facility Type	Operational Capabilities	Number of Facilities in TN	Comments
Publicly run baling facility	Direct baling of clean source-separated material	50	<ul style="list-style-type: none"> ✓ Most county facilities fit this category ✓ They use vertical or horizontal balers to manage OCC, ONP, mixed paper, and various plastics ✓ This material is typically collected source separated from convenience sites and recycling drop-off locations
Publicly run baling facility w/sorting	Accept mixed recyclables, process and bale sorted material in addition to direct baling source-separated material	4	<ul style="list-style-type: none"> ✓ Some counties manage sorting operations, usually with a manual sort line using a conveyor or they provide crude sortation on a tipping floor ✓ Most of these operations use a horizontal baler to manage the material they sort
Publicly owned MRF that is privately operated	Accept mixed recyclables, process material, then bale clean commodities for market	1	<ul style="list-style-type: none"> ✓ One county owns a recycling facility, with MRF operations provided as a contracted service
Privately run baling facility	Direct bale only clean source-separated material	9	<ul style="list-style-type: none"> ✓ There are several private baling facilities; these facilities usually source various fiber grades mostly from commercial and industrial clients ✓ Some material may be clean source-separated material collected from local government convenience sites
Privately run baling facility w/sorting	Accept some mixed recyclables, process and bale sorted material in addition to direct baling source-separated material	4	<ul style="list-style-type: none"> ✓ Some private baling facilities will accept mixed material, and provide a manual sort using a conveyor, or on the tipping floor ✓ These facilities are typically set up to manage clean loads of material for direct baling, but may provide some sorting for customers that request the management of mixed recyclables
Privately owned and operated MRFs	Accept mixed recyclables, process material, then bale clean commodities for market	8	<ul style="list-style-type: none"> ✓ There are a handful of larger capacity recycling facilities that are designed to accept mixed recyclables ✓ These facilities are classified as dual-stream or single-stream MRFs.



Recycling Processing Facilities Map:



This map shows the location for all public and private sector recycling processing facilities identified in Tennessee, broken down by facility type. All private recycling facilities are labeled on the map. For a detailed list of all the facilities identified here, please see the chart in Appendix II.



LOCAL END MARKETS

The recycling supply chain feeds industry in Tennessee. Strong markets exist across the state for plastic, paper, aluminum, and steel⁴.

Paper - Paper mills produce various grades of fiber using recycled feedstock including newsprint, tissue, boxboard, linerboard, and corrugating medium. Strong players in the industry have a presence in Tennessee including RockTenn, Temple-Inland, and Sonoco Products.

Aluminum – Alcoa, Bonnell Aluminum and other mills are located in Tennessee, and that serves as a strong end market for various grades of aluminum such as cans and structural aluminum scrap.

Plastic – Plastics enjoy end-market opportunities from automotive parts to fiber manufacturing. This market segment also includes secondary processors that purchase material from MRFs and other baling operations and produce the recycled resin, pellet, and flake that feed the manufacturers. Plastic recycling is regional in scale as well. Many secondary plastic processors are available outside of Tennessee. Much of this material is shipped out of state to secondary plastics processors and then back to Tennessee for use by manufacturers. Tennessee consumes more repro than it collects, while the capture rate is less than 10%. This is a lost opportunity for revenue to remain within the state.

Steel - Scrap steel is an easy item to market locally. Scrap yards and shredders that manage this material are regional networks. The next step after the scrap yard and shredder in the steel recycling process is access to a steel mill. These are facilities that create steel products for multiple uses such as plate, rod, beam, and rolled steel. Steel producers including Nucor and Gerdau Ameristeel have mills in Tennessee.

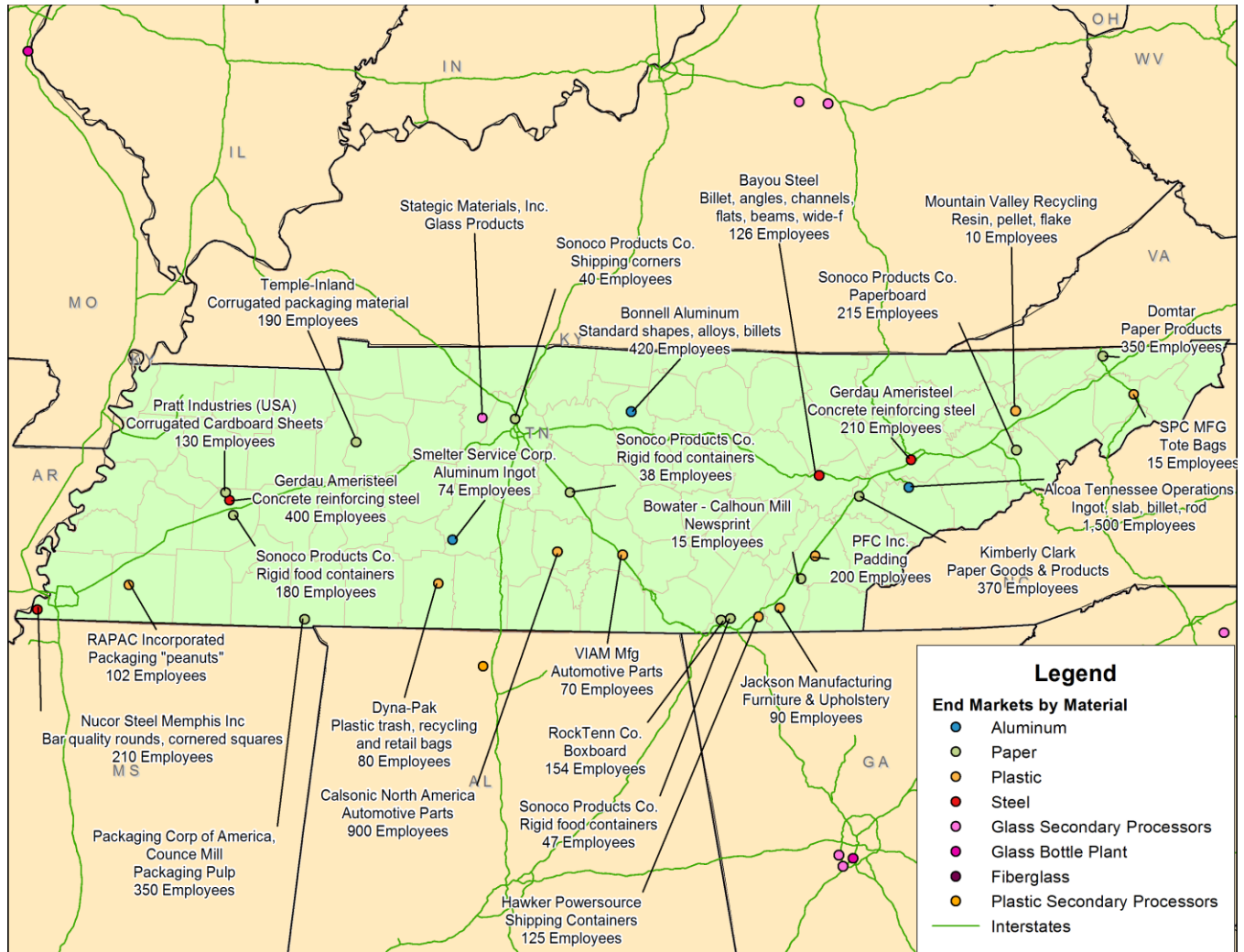
Glass – Secondary processing for glass is called “glass beneficiation.” This involves cleaning the glass by sorting out contaminants, as well as color sorting to create clean cullet. Glass beneficiation typically occurs in order to better manage post-consumer bottle glass. The clean cullet can then be used as furnace-ready material for the bottle market or size reduced to as small as powder form for various specialty end markets. Facilities that just consolidate and process clean material from industrial sources typically do not need this level of processing.

Secondary glass processors receive material directly from MRFs, drop-off sites, and industrial clients. Bottle-to-bottle recycling is a good high-volume end market for glass, and secondary glass processing creates an acceptable feedstock for making new glass bottles and jars. There is a market for industrial glass consolidation in Tennessee at Strategic Materials, Inc. They have a glass recycling facility located near Nashville, but this site does not accept post-consumer bottle glass. This report would recommend that TDEC encourage SMI to initiate bottle collection at their Ashland City, TN operation. Unfortunately bottle-to-bottle end markets for glass in Tennessee are not very strong, and furnace-ready cullet ultimately is shipped out of state on its way to bottle plants in North Carolina, Virginia, Indiana, or Georgia.

⁴ End-market data developed through SERDC study: Mapping Demand for Recycled Content Material, 2010.



Local End Markets Map:



This map shows industrial consumers of various recyclable materials. Each data point identifies the material used (color coded), provides the facility name, the product made, and number of employees.



END-MARKET PROFILES

Industries in Tennessee help drive the regional recycling economy. Material flows from communities to recycling facilities and then to various end users. Some of this material may leave Tennessee before being converted to a form for industrial use, then return to Tennessee to be consumed by a mill or manufacturer. This value-add process could include reprocessing plastic into a useable pellet, or taking that a step further and creating a staple fiber from the plastic pellet. That staple fiber – usually nylon, polyester, or polypropylene - can end up in the manufacture of carpet, clothing, or car headliners.

The same process illustrated above for plastic works for fiber too. Old corrugated containers (OCC) can go to a mill that makes linerboard; another mill can produce corrugating medium. These products can then be sold to container plants that convert the fiber to make a sheet of cardboard – the linerboard and corrugating medium are used to construct the cardboard sheet. The cardboard sheet product then gets made into boxes of many shapes and sizes for all sorts of products.

At each of the stops along the way, value is added. A secondary plastics processor might turn baled PET bottles into clean PET pellets (called repro in the plastics world). They buy the material from a MRF at the market rate for baled PET bottles, maybe \$.20/lb. After they clean and pelletize the PET, they can then sell it to a blow molder or yarn manufacturer for around \$.70/lb depending on the market. The PET flake or pellet can then be consumed for many uses. One use is conversion to a polyester staple fiber with the value pushing up into the range of \$0.90 to \$1.40/lb. These increased margins along the way are what create the value in the recyclable material that is collected at curbside. This is also what drives the recycling economy and creates feedstock for end users. Here's a snapshot of various end users in Tennessee and some data about their place regarding material end markets:

ALCOA TENNESSEE OPERATIONS			
Location Data	Material Consumed ⁵	Value Add ⁶	Municipal Recovery Input ⁷
Alcoa Tennessee Operations	Type: Aluminum cans Amount: At least 175,000 tons/year	Purchase price: Market price, currently \$.88/lb	Annual municipal recovery in TN of aluminum cans: 2,570 tons
Alcoa, TN Employees: 1,500	Distance range for sourcing supply: Domestic & International	Product manufactured: Rigid Container Sheet (RCS). Used to make new aluminum cans. Product value: Price range for RCS is in the \$1.50 to \$3.00/lb range (FOB seller's dock)	
End User Notes⁸: The Alcoa, TN plant is the largest aluminum can sheet mill in the world. This mill produces approximately 90% recycled content rigid container sheet. Alcoa closed its East Tennessee smelter in 2009. They no longer make aluminum from ore since the smelter shut down and currently alternatively use recycled feedstock. Alcoa sources material both domestically and internationally to meet mill demand. It is estimated that 2.3 billion cans were used in the state of TN in 2008. At a count of about 34 cans per pound it works out to 67.6 million lbs of aluminum cans consumed and available for recycling per year in TN, or 33,800 tons.			

⁵ Developed from conversions with Beth Schmitt, Director of Recycling Programs for Alcoa.

⁶ Pricing sources for aluminum products were determined from market data on Kitco.com and Alibaba.com.

⁷ Municipal recovery numbers from Re-Trac data through county solid waste reporting provided by TDEC.

⁸ From conversations with Beth Schmitt.



VICAM (VIAM MANUFACTURING)

Location Data	Material Consumed ⁹	Value Add ¹⁰	Municipal Recovery Input ¹¹
VICAM (part of VIAM Manufacturing) Manchester, TN Employees: 70	Type: PET (#1 plastic) bottles Amount: Capacity of 5,475 tons/year Distance range for sourcing supply: AL, SC, Japan	Purchase price: Clean, clear PET bottle resin (flake or pellet) market price, currently \$.70 - \$.89/lb Product manufactured: PET Staple Fiber Product value: Current market value range = \$2 to \$3/kg or \$0.90 to \$1.36/lb	Annual municipal recovery in TN of PET bottles: 3,800 tons
End User Notes¹²: <p>The company is a newly formed subsidiary of leading non-woven materials producer Japan Vilene Company (JVC) managed by VIAM Manufacturing and utilizes technology developed by Oyama Chemical. VICAM invested \$32 million to build a facility for the production of a polyester-based carpet fiber and opened in March 2012. This investment will produce 70 new jobs at full capacity.</p> <p>VICAM's new Manchester facility produces polyethylene terephthalate (PET) staple carpet fiber by recycling PET clear bottles, using Oyama Chemical's fiber technology. The carpet fiber will then be used in headliner, seat backs and door panels in the automotive industry.</p> <p>The plant is located on a 12-acre site that houses a 44,000 square foot facility with the capability for future expansion of 120,000 square feet. Future expansion plans include supplying PET staple carpet fiber to VIAM Manufacturing in its manufacture of automotive floor mats. As a producer of high quality, custom design floor, trunk and cargo mats, VIAM is a supplier for many of the big automotive companies, including Nissan North America, Inc.</p>			

⁹ Developed from conversations with Kimberly Martin, Buyer at VICAM.

¹⁰ Pricing sources for plastic products were determined from market data on dewittworld.com and plasticsnews.com.

¹¹ Municipal recovery numbers from Re-Trac data through county solid waste reporting provided by TDEC.

¹² From VICAM press release.



ROCKTENN – CORRUGATED SHEET PLANT

Location Data	Material Consumed ¹³	Value Add ¹⁴	Municipal Recovery Input ¹⁵
RockTenn Chattanooga, TN Employees: 154	Type: OCC, DLK Amount: 146,000 tons/year Distance range for sourcing supply: Supplied by 7 RockTenn mills producing linerboard and corrugating medium across Southeast	Purchase price: Market price, currently about \$500/ton (corrugating medium), and \$750/ton (linerboard) Product manufactured: Corrugated Cardboard Sheet 70 to 80 million square feet produced per month. Product value: About \$0.1 to \$0.2/sq ft (about \$2,000/ton)	Annual municipal recovery in TN of OCC: 70,000 tons
End User Notes¹⁶: RockTenn is one of North America's leading producers of corrugated and consumer packaging and recycling solutions. Based in Norcross, GA, they employ approximately 26,000 people and operate more than 240 facilities in the United States, Canada, Mexico, Chile, Argentina and China. RockTenn is vertically integrated and has many assets located in TN, including MRFs, mills, sheet plants and converting facilities. The Chattanooga corrugated sheet plant produced a record 93 million square feet of corrugated sheet in October 2012.			

OPPORTUNITIES

There are strong end markets in Tennessee for paper, steel and aluminum. Most of this material can move from MRFs or baling operations directly to paper, steel, and aluminum production mills. Plastics and glass need more processing. Both of these materials, especially when sourced from post-consumer residential sources, head from a MRF to secondary processors.

Much of the PET, HDPE, and PP plastic that is recovered in Tennessee is shipped out of state for processing. Industrial users that consume this material may purchase it from secondary processors located in a neighboring state.

There are a few of large secondary plastics processors relatively close to Tennessee. Large PET processors in Alabama (Custom Polymers PET), and North Carolina (Clear Path Recycling) provide much of their material to the carpet industry in Georgia. HDPE has a major processor in North Carolina (Envision Plastics). This facility pulls material from all across the region, and has the ability to produce color-sorted post-consumer resin for the bottle industry. They can also produce an FDA-approved post-consumer resin. Another big PP reclaimer is KW Plastics in Troy, Alabama. KW is the world's largest producer of custom-engineered, recycled polypropylene co-polymer resins. KW Plastics provides a steady supply of material to parts suppliers for the auto industry.

¹³ Developed from conversations with Joe Ward, Scheduler at RockTenn Sheet Plant in Chattanooga,

¹⁴ Pricing sources for linerboard, corrugating medium, and finished corrugated sheet were determined from market pricing on Paperage.com and Alibaba.com.

¹⁵ Municipal recovery numbers from Re-Trac data through county solid waste reporting provided by TDEC.

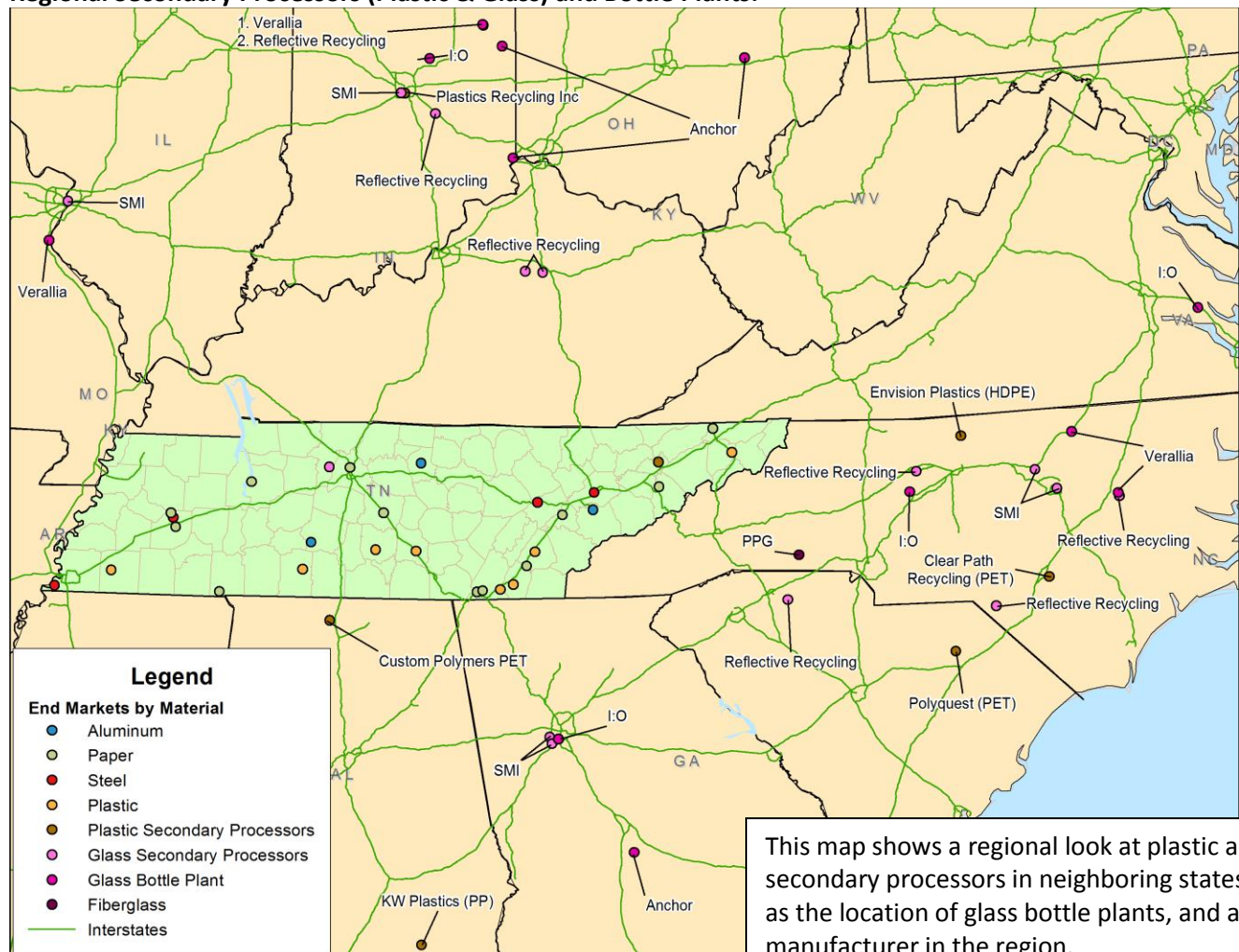
¹⁶ From RockTenn website and conversation with RockTenn employees.



Glass is another material that needs to head to a secondary processor. Glass beneficiation has two main competitors in the Southeast region. Strategic Materials (SMI), and Reflective Recycling have facilities throughout the Southeast and upper Midwest. These glass processing plants are usually located near a large supplier of glass, or close to an end user. Some of the largest end users of glass are bottle plants. Owens-Illinois (O:I), Verallia, and Anchor Glass are three of the largest in the Southeast. The glass bottle plants are interested in consuming furnace-ready cullet to make new glass bottles. These plants typically use around 40% to 50% recycled cullet in the production of new glass. They are all looking to increase this percentage to reduce energy costs, but the quality specification gets tighter as the glass plants increase their percent composition of recycled cullet. This makes the role of the secondary glass processor even more important to the bottle-to-bottle recycling of glass.

Without bottle production in Tennessee, a focus in three areas could drive the development of glass recycling end markets in the state. The first option is to increase the supply of glass. If there is a large, consistent supply a secondary processor may see this as an opportunity to locate closer to the supply source. Another opportunity would be to develop food or drink production in the state. Food and drink manufacturers typically need glass bottles and jars for their goods. If there is a large demand for finished bottles, there may be a need for a bottle plant to locate in-state. One additional option could be to set up more efficient transportation networks to existing secondary processor locations. This could be through the development of well-placed rail-loading and transportation options to processors in neighboring Georgia, North Carolina, or Kentucky.

Regional Secondary Processors (Plastic & Glass) and Bottle Plants:



LOCAL ACCESS TO RECYCLING MARKETS

The disposal data produced by SERDC is used with recycling market commodity prices to develop an estimate of the value for the focus materials currently disposed in the residential waste stream. With this data we have also developed a map that illustrates targeted areas of investment to support growth of the material processing infrastructure in Tennessee.

Using Tennessee-based information, SERDC has produced five community profiles to represent diverse collection system approaches for the state. These community profiles vary geographically as well as in the types of populations they serve – urban, suburban and rural. These community profiles consider programmatic parameters including drop-off, curbside collection, varied collection frequencies and varied material collection techniques (including dual stream, single stream and material multi-sort). These profiles outline current practices and identify how these varied programs can provide increased supply for recycling markets.

VALUE OF FOCUS MATERIAL IN RESIDENTIAL WASTE STREAM

RESIDENTIAL WASTE AS PART OF THE TOTAL DISPOSED WASTE STREAM

Residential disposal is taken as a percentage of total waste disposed in the state. Total disposal in 2011 was approximately 7.2 million tons¹⁷. Using estimates from county annual solid waste reports SERDC determined that statewide disposal from the residential sector was approximately 3.3 million tons¹⁸. This represents about 46% of total disposal. The focus materials in the residential disposed waste stream total just over 1.1 million tons¹⁹.

VALUE OF THE FOCUS MATERIAL DISPOSED

The five focus materials represent items most commonly targeted for recovery from the residential waste stream. Focus materials include paper, plastic, aluminum, steel cans, and glass bottles and jars. Paper and plastic are broad categories, but in the case of this model were limited to the following sub-groups:

Paper	Plastic
<ul style="list-style-type: none">➤ Mixed Office➤ Newspaper➤ Magazines & Catalogs➤ Cardboard➤ Paperboard & Boxboard	<ul style="list-style-type: none">➤ PET Bottles (#1)➤ HDPE Bottles (#2)

¹⁷ Total disposed tonnage determined from Re-Trac data through county solid waste reporting provided by TDEC.

¹⁸ Residential portion of disposed waste stream determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

¹⁹ Percent composition of focus material provided using [State of Georgia Waste Composition Study](#), 2008.



Annual residential disposal of 3.3 million tons was converted to pounds. This equals 6.6 billion lbs/year of residential disposal. Focus material was taken as a percent of total residential disposal. The pricing data was calculated using \$/lb averages for 2012, and totals about \$180.3 million for all the focus material²⁰.

VALUE OF FOCUS MATERIAL DISPOSED IN RESIDENTIAL WASTE STREAM			
Focus Material	Regional Average (1 year) \$/lb	% of Disposed Waste (state average)	Market Value
Aluminum Cans (Sorted, Baled \$/lb)	\$0.764	0.90%	\$51,482,500
Glass (Mixed)	\$0	4%	\$0
Paper (Soft Mixed Paper)	\$0.043	14%	\$29,743,100
Paper (OCC)	\$0.064	6%	\$24,275,700
Paper (Newsprint)	\$0.029	7%	\$9,861,700
Plastics (PET price)	\$0.273	3.1% (#1 & #2 bottles)	\$61,111,200
Steel Cans (Sorted, Loose Price)	\$0.041	1.70%	\$3,854,600
Total		36.4%	\$180,328,800

Estimates were very conservative in calculating the value of the focus material. Paper grade values were based on OCC, Newsprint (ONP) and soft mixed paper. Plastic pricing was based just on PET, which typically runs a few cents per pound less than HDPE. Glass was given a value of \$0/lb, but this material does have value in the recycling economy. Transportation factors weigh heavily on the market value of glass, and impact the market price for this material in Tennessee. The largest benefit to the recovery of residential glass is the cost savings associated with reduced tipping fees. Using an average tipping fee of \$35/ton as a cost savings for glass, there is a potential cost savings value of \$4.5 million. The same cost savings bonus can be added for all the focus materials, and is not included in the value calculation in the chart above.

The market value calculation is designed to illustrate part of the economic impact due to the recovery of these materials. As these commodities move up the value chain, their market price grows as value is added. Depending on the material the multiplier can vary. This is the margin that creates the recycling economy, and provides the backbone for a green supply chain in the manufacturing of goods.

It is also noted that the value calculation above only includes material in the residential waste stream, and does not address focus material in the commercial waste stream. That sector makes up another source of supply, which adds to the value of material in the disposed waste stream.

TARGETED AREAS OF SUPPLY IMPACT

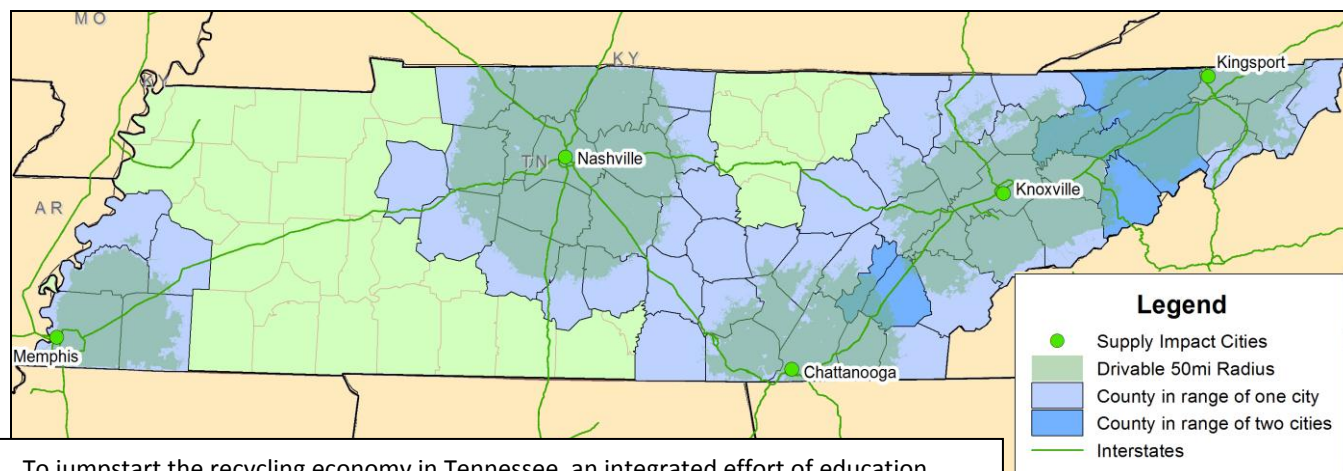
MRF access near population centers will create the infrastructure to grow diversion and push material into the recycling economy. Across the state, local communities have varied programs collecting a range of different materials. Some include glass; others do not. Some collect all plastic; others just plastic bottles. A growing number of communities have moved to single-stream programs, others still source separate. Some single-stream programs accept cartons (gable-top containers and juice/wine/soup boxes) – which are a growing portion of the waste stream – and others do not. These are just a few examples of the variation in collection

²⁰ Pricing Data was accessed through *Recycling Data Management Announced Recovered Material Prices, 2012*.



programs. Integration across Tennessee will help to broaden the list of materials collected, drive more diversion, and create the critical mass to grow the recycling economy.

The map below illustrates the impact for MRF development in five population centers across Tennessee. Mapping a 50-mile driving radius from the middle of each population center provides an overview of the area that could be serviced from these locations through a network of regional MRFs.



- To jumpstart the recycling economy in Tennessee, an integrated effort of education, collection, and processing needs to occur.
- The darker-green areas represent a 50-mile driving radius from each population center (titled “supply impact cities”). The light blue counties are the counties that touch the 50-mile driving radius. Dark blue counties are in a 50-mile range of two cities.
- This map represents the transportation range for getting collected recyclables to processing infrastructure located in population centers in Tennessee. The chart below provides more details.

Moving toward a processing model that involves a network of single-stream MRFs is one strategy to drive more diversion. At this time, only 44 cities and towns in 26 counties collect recycling through curbside recycling programs, and only 38 of those collect material commingled²¹. The remaining counties and municipalities rely on varied programs designed around convenience sites and recycling drop-off locations.

Number of single stream MRF's	Current throughput (tons)
9	265,150 ²²

Investing in large, centralized single-stream MRFs allows these facilities to invest in more automated sorting including separation screens and optical sorting equipment. These upgrades and operating two shifts will further lower the operating costs of the MRFs and increase the distance that material can economically be shipped to these facilities. This system is called a hub-and-spoke network and is employed by all large waste haulers. With access to this infrastructure, communities can more realistically look to roll carts and single-stream collection as a core to their recycling services. Local governments can focus their investment on collection and education, and private sector firms or larger municipalities through partnerships can invest in the processing infrastructure

²¹ Program information was determined from Re-Trac data through county solid waste reporting provided by TDEC, and conversations with TDEC staff.

²² Tonnage number is based on discussions with MRF operators. This is an aggregate number for all facilities. Some of this total includes commercial tonnage in addition to residential.



needed to generate commodity grade products. There is still a need for specialty recyclers and baling operations to manage commercially-generated material. The strategy around targeted areas of investment focus primarily on the supply generated from municipalities through the management of residential recycling collection programs, but this same network could also pull in commingled recyclable material from the commercial and institutional waste stream.

TARGETED AREAS OF SUPPLY IMPACT			
Targeted Locations	TN Counties Touching 50-Mile Driving Radius	# of Households ²³	Additional Supply Available (tons) ²⁴
Chattanooga	Bledsoe, Bradley, Franklin, Grundy, Hamilton, Marion, McMinn, Meigs, Polk, Rhea, Sequatchie, Van Buren, Warren	310,910	62,500
Kingsport	Carter, Johnson, Grainger, Greene, Hamblen, Hancock, Hawkins, Sullivan, Unicoi, Washington	273,640	52,550
Knoxville	Anderson, Blount, Campbell, Claiborne, Cocke, Cumberland, Jefferson, Knox, Loudon, Monroe, Morgan, Roane, Scott, Sevier, Union	530,160	97,450
Memphis	Fayette, Haywood, Lauderdale, Shelby, Tipton	473,710	95,394
Nashville	Bedford, Cannon, Cheatham, Coffee, Davidson, DeKalb, Dickson, Hickman, Humphreys, Macon, Marshall, Maury, Montgomery, Robertson, Rutherford, Smith, Sumner, Trousdale, Williamson, Wilson	823,470	175,520
Total	67 counties	2,391,890	483,140

The chart above shows the impact on counties that touch a 50-mile drive radius from various population centers. This chart illustrates the access and impact that an integrated network of processing facilities and collection systems could have on communities in Tennessee. Increased diversion from residential recycling programs could drive economic growth from this sector. See a breakdown of the additional supply below. The supply is shown next to current demand from the three end user profiles detailed earlier in this report.

Focus Material	Breakdown of Additional Supply (tons) ²⁵	Current Demand – from 3 end user profiles (tons)
Paper	265,727	146,000 (OCC)
Aluminum	14,494	175,000 (Aluminum cans)
Steel	19,325	---
Plastic	48,314	5,475 (PET)
Glass	82,134	---
Total	483,140	---

²³ Number of households per county was determined from Re-Trac data provided by TDEC.

²⁴ Tonnage estimates are based on the recovery of 50% of the focus materials in the residential waste stream.

²⁵ Breakdown of single-stream material based on Resource Recycling “A Common Theme,” Collins, S. February 2012.



The economic growth will come from the market value of recovered material, investment in collection and processing infrastructure, job growth, efficiencies in transport and collection, and decreased disposal costs for local government. See the chart below for details on the high level economic impact per 10,000 tons of additional diversion. The 68 jobs are direct jobs in the recycling industry resulting from 10,000 tons of additional diversion. The direct jobs will have a multiplier effect that creates an additional number of induced and indirect jobs.

ECONOMIC DEVELOPMENT IMPACT PER 10,000 TONS OF ADDITIONAL DIVERSION (SINGLE-STREAM MATERIAL)	
Capital Investment²⁶	
Collection Trucks	\$281,250
Carts	\$500,000
MRF Infrastructure	<u>\$400,000</u>
	\$1,181,250
Market Efficiencies²⁷	
Avoided Disposal	\$350,000
Material Value	<u>\$1,510,200</u>
	\$1,860,200
Job Growth²⁸	
Material Collection	10
MRF Operations	10
Plastic Manufacturing	9
Glass Manufacturing	4
Paper Mills	10
Recycling-Based Manufacturers	<u>25</u>
	68

Direct job growth based on additional supply	
Additional Supply (tons)²⁹	Total Jobs Created³⁰
483,140	3,285

Direct jobs missed-out on based on disposal of residential focus material	
Disposed (tons)	Total Jobs
1,100,000	7,480

²⁶ Collection trucks: 10 @ \$225,000 each = \$2.25 million, initial investment amortized over 8 years. Carts: @ \$50/95-gallon cart, estimated 50,000 carts needed per 10,000 tons, amortized over 5 years. MRF Infrastructure: Building amortized over 20 years, equipment over 10.

²⁷ Avoided Disposal: Residential disposal cost estimate based on \$35/ton tipping fee. Material Value: % mix of single-stream material based on Resource Recycling "A Common Theme," Collins, S. February 2012. Value is based on pricing from material value chart above.

²⁸ Jobs data from Institute for Local Self Reliance (jobs per 10,000 TPY), *Recycling Means Business*, 2002.

²⁹ Additional Supply from "Areas of Supply Impact" chart on previous page.

³⁰ Jobs Created based on job numbers from "Economic Development Impact" chart above.



COMMUNITY PROFILES

Material in the residential waste stream is generated in communities across Tennessee. From urban centers like Nashville and Memphis, to suburban and rural communities like East Ridge and Lewisburg.

Each of these communities plays a role in the recovery of material that drives the recycling economy in Tennessee. The infrastructure available in each community may vary, but the integration of all these players is what pushes the flow of recovered material. This creates the economic engine called recycling that drives the supply chain, and feeds industry across Tennessee and the Southeast.

Below are community profiles for a diverse collection of municipal and county recycling programs. These profiles are meant to discuss various methods used for residential recovery, and highlight options to divert more material and grow the recycling economy in Tennessee.

CITY OF NASHVILLE (URBAN, CURBSIDE/DROP-OFF)			
Location Data ³¹	Service Scenario ³² Highlights	Diversion & Disposal ³³ (Residential)	Options for Increased Recovery
City of Nashville Population: 601,222 # of Households: 242,474 # Households served by city curbside program in Urban Services District: 140,000 (population of 429,421) Remaining Households: Have recycling drop-off sites and convenience centers, or can contract with private hauler for curbside recycling collection.	Type of collection: Curbside w/95-gallon roll carts in Urban Services District. Drop-off sites and convenience centers for other parts of the city. Frequency: 1X/month for curbside. 13 recycling drop-off sites, and 3 convenience centers. Facility used: Waste Management, Inc. Distance to recycling facility: Nashville, in-town.	TPY collected: Curbside, 11,660 Curbside and drop-off, 20,069 Pounds per household collected: Curbside only, 167 Curbside & drop-off, 166 Residential disposal (tons): 308,400 Focus materials in residential disposal (tons): 110,000	✓ Focus area = Access & collection frequency ✓ Nashville has very well-rounded recycling programs and range of services. With residential recycling, adjusting collection frequency (from 1X/month to 1X/week or EOW), and offering curbside recycling service to all city residents is an investment that will drive increased diversion. ✓ Focus material in the residential disposed waste stream if recovered at an attainable level of 50%, will add 55,000 tons of material to the recycling economy in TN.
Materials accepted³⁴: All paper and boxes (including cartons), all plastic bottles and containers (including tubs, lids, and plastic trays), all metal and aluminum cans. Glass bottles and jars can be recycled at drop-off sites and convenience centers only. Materials not accepted in carts are glass, and soiled food containers such as pizza boxes, black plastics, plastic toys, plastic bags, Styrofoam and plastic clamshell containers.			

³¹ From phone conversation with City of Nashville staff, and US Census Bureau data.

³² From phone conversation with Sharon Smith, Metro Nashville Public Works.

³³ TPY recovery data pulled from City of Nashville website. Disposal tonnage determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

³⁴ Recycling program information from City of Nashville website.



CITY OF EAST RIDGE (SUBURBAN, CURBSIDE)

Location Data ³⁵	Service Scenario ³⁶ Highlights	Diversion & Disposal ³⁷ (Residential)	Options for Increased Recovery
City of East Ridge Population: 21,259 # of Households: 9,996 # of Households with access to carts in 2012: 1,791	Type of collection: Curbside w/95-gallon roll carts Frequency: Every other week Facility used: RockTenn Distance to recycling facility: Chattanooga, 7 miles	TPY collected: 395 Pounds per household collected: 79 (441 lbs/household based on number of households w/access to carts in 2012) Residential disposal (tons): 15,700 Focus materials in residential disposal (tons): 5,700	✓ Focus area = Access ✓ East Ridge recently started a curbside single-stream recycling program using roll carts. This is a free subscription service offered by the city. East Ridge has a high degree of interest in the program from residents, and currently there is a waiting list to receive a recycling cart. ✓ East Ridge should invest in the carts and collection infrastructure needed to offer curbside recycling service to all the households in the city. If the city as a whole recycles at the same lbs/household rate as those that currently have curbside access, then East Ridge could see an increase of over 1,800 tons per year of diversion.
Materials accepted³⁸: All paper and boxes (including cartons and paperback books), all plastic bottles and containers (including tubs, lids, and plastic trays), all metal and aluminum cans, glass bottles and jars, and plastic bags. See their flyer.			

³⁵ From phone conversation with City of East Ridge staff, and US Census Bureau data.

³⁶ From phone conversation with Amanda Miller, City of East Ridge Sanitation Department.

³⁷ TPY recovery data from Amanda Miller, City of East Ridge. Disposal tonnage determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

³⁸ Recycling program information from City of East Ridge website.



CITY OF LEWISBURG (RURAL, CURBSIDE)

Location Data ³⁹	Service Scenario ⁴⁰ Highlights	Diversion & Disposal ⁴¹ (Residential)	Options for Increased Recovery
City of Lewisburg Population: 11,195 # of Households: 5,071 # of Households with access to curbside: 4,000	Type of collection: Curbside w/35-gallon roll carts in City of Lewisburg Frequency: 1X/week for curbside Facility used: Marshall County Solid Waste Distance to recycling facility: Lewisburg, in-town	TPY collected: 1,229 Pounds per household collected: 485 Residential disposal (tons): 2,800 Focus materials in residential disposal (tons): 1,010	<ul style="list-style-type: none"> ✓ Focus area = Added materials and curbside collection capacity ✓ Lewisburg provides single-stream curbside recycling, and delivers this material to the county for processing. The county operates the recycling facility, as well as drop-off sites to collect additional material. This is a great partnership that drives a successful rural recycling program. ✓ Lewisburg could push the envelope and set a goal for diversion of 750 lbs/household. This works out to 670 tons per year of additional diversion, or about 50% more than is currently recovered. ✓ The goal could be reached through adding glass to the curbside mix (or collected separately at curbside), and offering larger capacity curbside carts to residents.
Materials accepted⁴²: Plastic, tin, and aluminum containers (including plastic tubs and lids), “anything that tears” paper products (including paperback books). See their flyer.			

³⁹ From phone conversation with Marshall County staff, and US Census Bureau data.

⁴⁰ From phone conversation with Morgan Thomas, Marshall County Solid Waste.

⁴¹ TPY recovery data from Re-Trac, and Morgan Thomas, Marshall County Solid Waste. Disposal tonnage determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

⁴² Recycling program information from Marshall County website.



FENTRESS COUNTY (RURAL, DROP-OFF)

Location Data ⁴³	Service Scenario ⁴⁴ Highlights	Diversion & Disposal ⁴⁵ (Residential)	Options for Increased Recovery
Fentress County Population: 18,020 # of Households: 8,760	<p>Type of collection: Drop-off convenience centers for residents. County-operated curbside recycling program for businesses.</p> <p>Frequency: 8 drop-off convenience center locations, box-truck collection for flattened OCC and other bagged recyclables from businesses.</p> <p>Facility used: Fentress County Recycling Center. Sell sorted & baled plastic and paper to RockTenn - Knoxville.</p> <p>Distance to recycling facility: Jamestown, in-town. Knoxville, 90 miles</p>	<p>TPY collected: 3,150*</p> <p>Pounds per household collected: 719*</p> <p>Residential disposal (tons): 4,300</p> <p>Focus materials in residential disposal (tons): 1,550</p>	<ul style="list-style-type: none"> ✓ Focus area = Integration, processing efficiencies ✓ Fentress County works hard to make recycling successful in this rural county. ✓ The county provides a labor-intensive processing operation for material collected from drop-off sites. They produce clean bales for 3 grades of plastic, OCC and mixed paper, as well as color-separated glass and crushed aluminum cans. ✓ The baled material is marketed through RockTenn in Knoxville. ✓ Switch labor and capital investment focus from processing to collection and education. ✓ Integrate collection programs for residents, businesses and schools. ✓ Provide for a dual or single-stream approach that makes best use of county resources. ✓ Compact or transfer dual or single-stream material for transport to RockTenn in Knoxville for processing. ✓ Use staff time recovered from processing for coordination of collection operations.
<p>Materials accepted⁴⁶: Collecting cardboard, newspaper, magazines, mixed paper (no cartons), aluminum and steel cans, #1 - #7 plastics, and glass bottles and jars.</p>			
<p><i>*includes residential and commercial tonnage collected by Fentress County</i></p>			

⁴³ From US Census Bureau data.

⁴⁴ From phone conversation with Faye Dalton, Fentress County Solid Waste.

⁴⁵ TPY recovery data from Re-Trac, and Fentress County Solid Waste. Disposal tonnage determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

⁴⁶ Recycling program information from Fentress County Solid Waste staff.



CITY OF GERMANTOWN (SUBURBAN, CURBSIDE)

Location Data ⁴⁷	Service Scenario ⁴⁸ Highlights	Diversion & Disposal ⁴⁹ (residential)	Options for increased recovery
City of Germantown Population: 40,123 # of Households: 13,703 # of Households with access to curbside: 13,300	Type of collection: Curbside w/35-gallon roll carts Frequency: 1X/week Facility used: RockTenn Distance to recycling facility: Memphis, 18 miles	TPY collected: 2,679 Pounds per household collected: 391 Residential disposal (tons): 23,400 Focus materials in residential disposal (tons): 8,500	<ul style="list-style-type: none"> ✓ Focus area = Curbside collection capacity, added materials, and incentive program ✓ 35-gallon curbside carts are a good start, but moving to a 95-gallon cart will provide more capacity for collection from residents; or provide cart options to residents that request more capacity. ✓ Provide recycling carts to all city households not just those that request one. ✓ Expand the list of materials accepted at curbside to include plastic tubs and lids, mixed rigid plastics, and cartons (such as gable-top containers, and juice/soup/wine boxes). ✓ This may require looking for additional MRF options, or working with your MRF operator to broaden the list of accepted material. ✓ Education campaign centered on growing diversion through single-stream curbside recycling. ✓ Incentive program such as RecycleBank could be a cornerstone for education efforts.
<p>Materials accepted⁵⁰: Newspaper, magazines, junk mail, phone books, office paper, catalogs, corrugated cardboard containers, boxboard, glass containers, all narrow neck plastic bottles and tops, metal food cans without lids, aluminum beverage cans, and foil clean of food.</p> <p>Materials not accepted in carts are plastic bags, tubs (any plastic that is not a narrow necked bottle), pots, foam egg cartons, pizza boxes or other food contaminated containers, and Styrofoam.</p>			

⁴⁷ From phone conversation with City of Germantown staff, and US Census Bureau data.

⁴⁸ From phone conversation with Joseph Nunes, City of Germantown Solid Waste & Recycling.

⁴⁹ TPY recovery data from Joseph Nunes, City of Germantown Solid Waste & Recycling. Disposal tonnage determined using data developed from Resource Recycling Systems (RRS), database development details available in Appendix I.

⁵⁰ Recycling program information from City of Germantown website.



CONCLUSIONS

Tennessee's Demand for Recycled Content Manufacturing Feedstock Outstrips Supply: Tennessee manufacturers look to good affordable feedstock to make consumer products for the Tennessee, national, and international marketplaces. In step with national trends, those companies increasingly look to recycled content materials to make consumer goods; but local sourcing remains a challenge. While plentiful regionally-based capacity to turn today's bottles, cans, and paper products into tomorrow's car parts, tools, and packaging materials exists, the infrastructure is low on supply. The material is there – it's just not being recovered for recycling. Supporting increased collection of recyclables at the local level can help to fill the gap between growing demand and plateaued supply thus engaging Tennessee's workforce. Current supply structures look to neighboring states' to fill material and labor requirements.

Lost Material is Lost Opportunity: When manufacturing feedstock is imported to Tennessee, millions of Tennessee dollars are sent to neighboring states. There is a net trade imbalance in Tennessee's recycling value chain. Increased collection retains these monies in Tennessee, leading to direct and indirect job growth.

Fueling Tennessee's Recycling System Fuels Tennessee's Manufacturing Base: Access to recycling drives public participation and impacts diversion. Access married with education, outreach, and incentive programs around recycling will impact diversion for the long term. Long-term diversion performance will drive economic development around materials management. Economic development as it relates to recycling means jobs and investments that are local in scale, and function as utility-based operations that scale up as a region grows.

Local Investment Feeds State-Level Return: Investment will occur at the local level around collection infrastructure. Investment will occur in the private sector around primary and secondary processing, and with industrial development around product-specific manufacturing to feed regional industrial material needs.

Engaging Multiple Sectors Grows Marketplace Value for Tennessee: Value will be generated as material moves from generation to collection, processing, and end markets. The value-add at each step along the way is what will drive the recycling economy. The more volume available, the larger the economic impact of material diversion.

Good Jobs for Tennessee's Workforce: Jobs are created as access drives diversion, investment, and value. The higher material moves along the value chain, the greater the impact around job creation.

Gauging Return on Investment, Projecting Impact: Modern solid waste reporting together with GIS data provide tools for the municipalities, counties and TDEC to accurately and objectively develop a material management plan. A plan that integrates the many existing resources and capital infrastructure to provide for improved recycling access. Building collaboratively upon existing resources will minimize the need for additional capital investment. Using these available tools to develop advanced solid waste and recycling plans will increase material capture, leading to solid job growth in Tennessee.

Current Data Needed to Move Forward: The State of Tennessee is in the early stage of developing a state-wide solid waste management plan and integration can be developed through that solid waste planning process. Sustainable materials management and integration of recycling and investments in recycling will be an important piece of this planning. Integration will involve input from the public and private sectors, as well as investment planning on the part of municipalities, industry, and public/private partnerships.



Appendix I

Glossary of Terms

ALUMINUM CANS: “Aluminum Cans” shall mean all containers consisting of primarily of aluminum metal; these are typically used beverage containers. Aluminum foil (not heavy contaminated with food) may also be accepted with aluminum cans.

BALE: “Bale” shall mean a compacted and bound cube of recyclable material.

COMMINGLE: “Commingle” shall mean the mixing of different types of recyclables that are collected together into a single container. This process makes it easier to recycle because it allows many different recyclables to be collected on a single container rather than one for each type of material. Materials are sorted, processed and marketed after collection from the single container.

COMMINGLED CONTAINERS: “Commingled Containers” (also referred to in campus recycling materials as “Bottles and Cans”) shall mean the commingled collection of the materials listed in the following categories: Aluminum Cans, Glass, Plastic and Steel Cans.

COMMINGLED FIBER: “Commingled Fiber” for purpose of this bid is the commingling collection of Newspaper, Magazines, Office Fiber, Mixed Paper and Phonebooks into one single container.

COMPACTOR: Equipment that uses pressure to densify and contain recyclable material.

COMPOSTING: “Composting” shall mean the process of decomposition or decay of organic wastes, such as leaves, food, paper, and sometimes municipal solid waste. The end product of composting is a humus-like material that can be added to soils to increase soil fertility, aeration and nutrient retention.

CONSTRUCTION AND DEMOLITION WASTE (C & D): “C&D” shall mean waste from both homeowners’ and contractors’ projects. C&D waste includes “concrete, bricks, lumber, masonry, road paving materials, rebar and plaster.”

DIRTY MRF: Dirty MRFs accepts refuse and recyclable materials mixed together. Separation occurs at the plant. After sorting/separation recyclable materials are sent to pre-processors. Residual materials that are not suitable for processing are disposed.

DUAL STREAM: A recycling process in which cans and bottles are collected separately from paper products.

GAYLORD CONTAINER: It refers to the trade name for a large reusable corrugated container used for shipping materials.

GLASS: “Glass” shall mean all empty bottles and jars made of clear, green, blue or brown glass. Expressly excluded from this definition are lead crystal, porcelain, ceramic products, mirrors, tempered or plate glass and light bulbs.



HUB and SPOKE: Recycling model that consists of a centralized processing center for recyclables, or “hub”, where material is sorted, baled, and/or sold to market. The “spokes” are the surrounding communities that feed the recyclables they collect to the main hub.

LANDFILL: Specially engineered site for disposal of solid waste on land. It is generally spread in thin layers which are then covered with soil.

MAGAZINES: “Magazine” shall mean magazines, periodicals, glossies or serials publications.

MATERIAL RECOVERY FACILITY (MRF): A facility where recyclable materials are separated from solid waste and processed for sale to various markets.

MIXED PAPER: “Mixed Paper” means the collection of low-grade paper other than newspaper, magazines, phonebooks, white paper or office fiber. It includes, but is not limited to printed or unprinted sheets, shavings and cuttings of colored or white paper with colored or black inks, paper grocery bags, cereal boxes and junk mail. It will include higher grades of fiber such as notebook paper, printer paper, test booklets, newspapers, magazines, glossy magazines, periodicals, catalogs and phonebooks.

MUNICIPAL SOLID WASTE (MSW): “MSW” shall mean residential and commercial waste generated by a particular municipal area however, it does not include medical or industrial waste.

PLASTIC CONTAINERS: “Plastic Containers” shall mean all empty containers made of polyethylene terephthalate (PET), commonly labeled #1; high density polyethylene (HDPE), commonly labeled #2; polyvinyl chloride (PVC), commonly labeled #3; low density polyethylene (LDPE), commonly labeled #4; polypropylene (PP), commonly labeled #5, polystyrene (PS), commonly labeled #6; or mixed plastic, commonly labeled #7. Plastic bottles are containers in which the neck is smaller than the base. These are usually blow-molded. Plastic tubs and rigids are plastics that are usually injection-molded. These can include special event cups, pipette tip boxes and other shaped plastic items or containers.

RECYCLABLE(S): “Recyclable(s)” shall mean those materials identified by the University for collection, processing, recovery or reuse as part of the University Outdoor Recycling Program.

RECYCLING SITE(S): “Recycling Site(s)” shall mean any outdoor point within four (4) feet of a contractor-serviced container or within the confines of any physical barrier (e.g. wall, fence) specifically delineating an OWRR outdoor recycling area.

ROLL CART: “Roll cart” shall mean carts on wheels used for recycling. The wheels facilitate transportation to the curbside or to the hauling truck.

SINGLE STREAM: A recycling process in which materials are collected all together with no sorting required.

SOURCE SEPARATED: “Source separation” shall mean the sorting of different materials such as glass, metals, paper and plastics at the point of generation prior to materials collection/disposal.

STEEL CANS: “Steel Cans” shall mean containers consisting of primarily steel. Empty, non-hazardous aerosol and paint cans are included unless otherwise specified in the Technical Proposal/Attachment.

TRANSFER STATION: Facility that receives and consolidates solid waste from collection trucks and other vehicles and loads the wastes onto tractor trailers, railcars or barges for long-haul transport to a distant disposal facility.



WASTE DIVERSION: The act of preventing waste from being disposed into landfills and incinerators.

WASTE STREAM: The flow of materials from generation to disposal.

YARD WASTE: “Yard waste” shall mean leaves, grass clippings and other organic wastes produced as part of yard and garden development and maintenance.

ZERO WASTE: Refers to reduce solid waste generation waste to zero, or as close to zero as possible by minimizing.



Appendix II

Methodology

➤ Disposal Numbers – Residential and Commercial Portion of Disposed Waste Stream

- RRS has developed estimates of packaging material landfilled by County, based on national projections.
- These estimates were developed from 27 different landfill waste composition studies from across the country.
- For each study, RRS summarized the percent composition of each material, standardized the list of materials and determined two different generation rates: pounds of residential material landfilled per capita and pounds of commercial material landfilled per employee.
 - Standard List of Materials for Packaging and Printing and Writing Paper
 - High Grade Office
 - Mixed Office
 - Low Grade - General & Other Recyclable
 - Newsprint (ONP)
 - Magazines and Catalogs
 - Paper Bags
 - Phonebooks and Directories
 - Hard-bound Books
 - Old Corrugated Containers (OCC)
 - Paperboard/Boxboard
 - Aseptic/Cartons
 - Polycoated Paper
 - PET Bottles
 - PET Containers Non-bottles
 - HDPE Bottles
 - #3 - #7 Plastics
 - Aluminum Cans
 - Tin/Steel Cans
 - Glass
- Each study was categorized as a low, medium or high diversion area based either on data included in the study or other available data:
 - Low diversion: < 15%
 - Medium diversion: 15% – 40%
 - High diversion: > 40%
- The average percent and landfill disposal rate were averaged for all studies in the category.
 - Low diversion residential: 437 pounds per capita per year (41% of total waste)
 - Medium diversion residential: 213 pounds per capita per year (31% of total waste)
 - High diversion residential: 114 pounds per capita per year (23% of total waste)



- Low diversion commercial: 740 pounds per employee per year (50% of total waste)
- Medium diversion commercial: 287 pounds per employee per year (33% of total waste)
- High diversion commercial: 134 pounds per employee per year (21% of total waste)
- Average landfilled packaging material rates were applied to each County's employment and population (from 2010 census data)
- Landfill waste composition studies considered for this study were:
 - Low Diversion – Residential
 - Chicago
 - Nebraska
 - Tennessee
 - Medium Diversion - Residential
 - Illinois
 - Iowa
 - Oahu
 - Pennsylvania
 - Snohomish County, Washington
 - Wisconsin
 - High Diversion - Residential
 - California
 - Clark County, Washington
 - Connecticut
 - Palo Alto, California
 - San Francisco
 - Seattle
 - Snohomish County, Washington
 - Washington
 - Low Diversion – Commercial
 - Chicago
 - Illinois
 - Nebraska
 - Ohio
 - Pennsylvania
 - Tennessee
 - Medium Diversion – Commercial
 - Connecticut
 - Iowa
 - Palo Alto, California
 - Wisconsin
 - High Diversion – Commercial
 - California
 - Clark County, Washington
 - Oahu
 - San Francisco



- Snohomish County, Washington
 - Washington
- In some cases different parts of a study were used for different diversion rates. For example, Snohomish County broke their waste characterization into single-family, multi-family and self-haul. The single-family and self-haul were used in the high diversion calculations while the multi-family was used in the medium diversion.

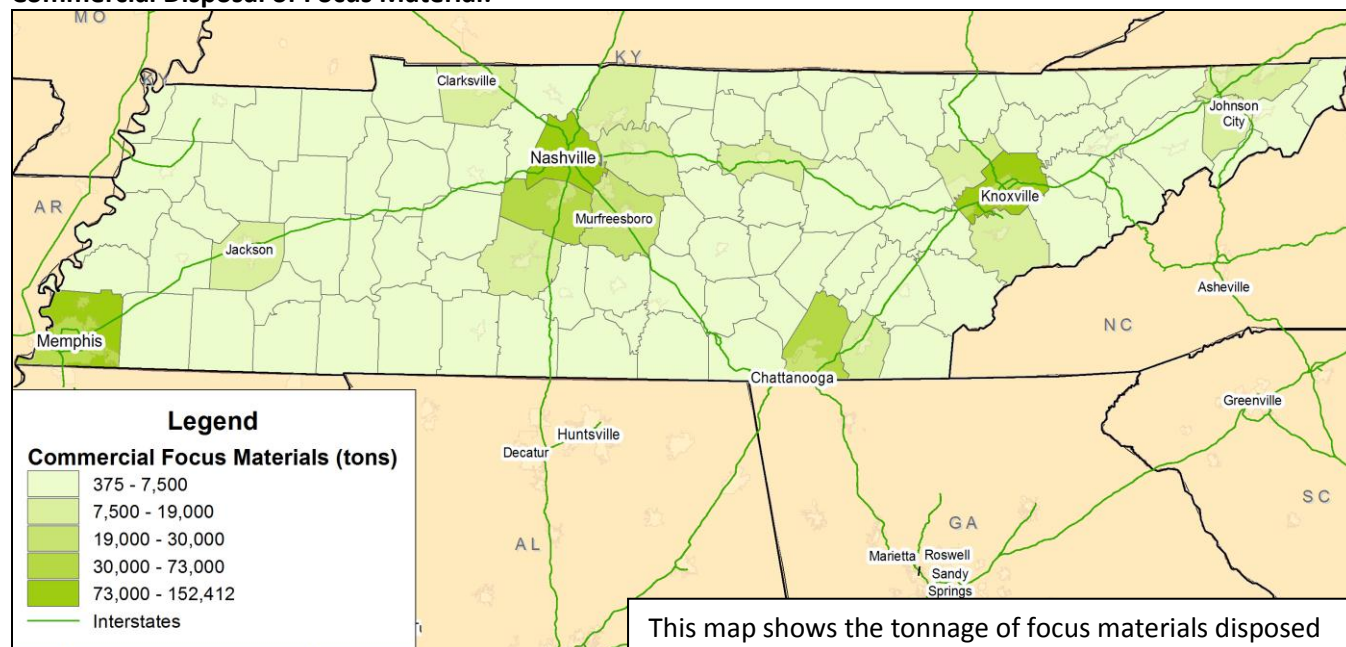


Appendix III

Additional Maps & Charts

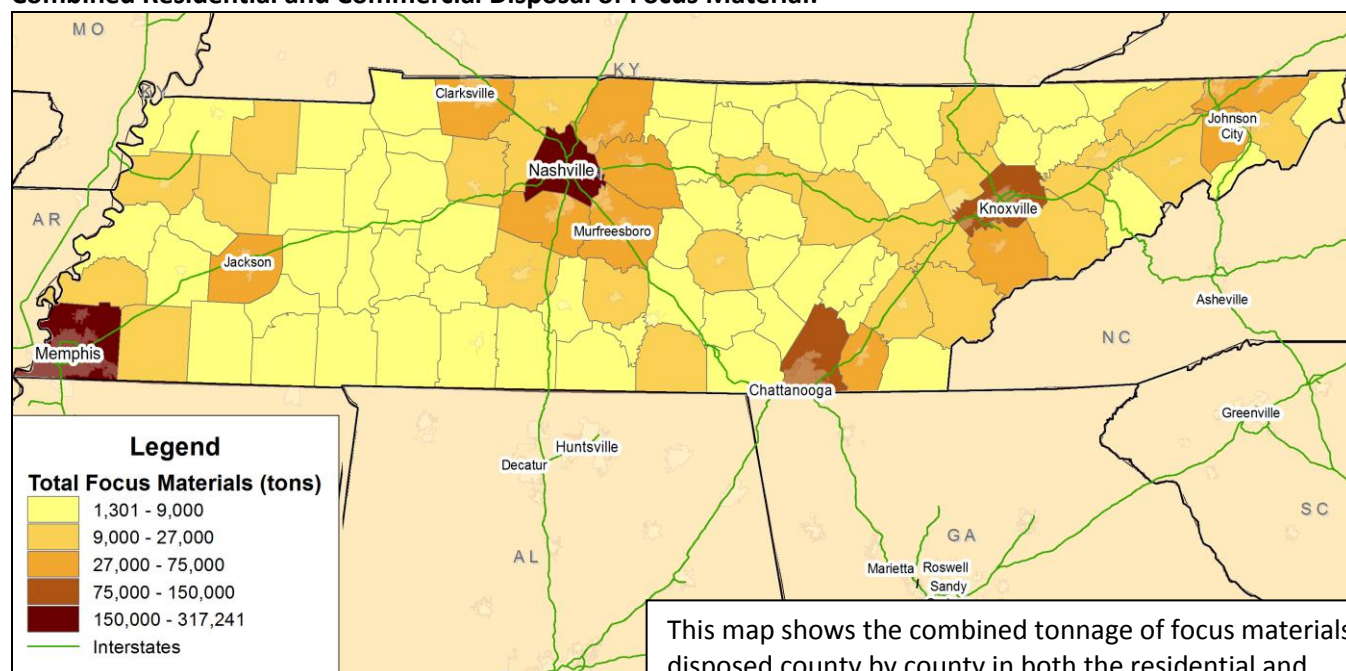
MAPS

Commercial Disposal of Focus Material:



This map shows the tonnage of focus materials disposed county by county in the commercial waste stream.

Combined Residential and Commercial Disposal of Focus Material:



This map shows the combined tonnage of focus materials disposed county by county in both the residential and commercial waste streams.



LIST OF ALL RECYCLING PROCESSING LOCATIONS (PUBLIC/PRIVATE)

County Location	Public Facility (y/n)	Name
Bledsoe	y	Landfill Convenience Center
Campbell	y	Towe String Road
Cannon	y	Woodbury Convenience Center
Carroll	y	Carroll County Convenience/Recycling Center
Carter	y	Carter County Recycling Center
Cheatham	y	South Cheatham Convenience Center
Chester	y	Chester County Recycling Center
Claiborne	y	Claiborne County Landfill
Clay	y	Clay County Sanitation Department
Cocke	y	Newport Recycling Center
Coffee	y	Tullahoma Public Works
Cumberland	y	Cumberland County Recycling Center
Decatur	y	Decatur County Fairgrounds
DeKalb	y	DeKalb County Landfill
Dickson	y	Dickson County Landfill
Fayette	y	Fayette County (Rural)
Fentress	y	Fentress County Recycling Center
Franklin	y	Franklin County Solid Waste Management and Recycling Center
Greene	y	Greene County Solid Waste Facility
Hardeman	y	Hardeman County Landfill
Hardin	y	Hardin County Solid Waste Shop
Hawkins	y	Hawkins County Materials Processing Facility
Haywood	y	Haywood County Recycling Center
Henderson	y	Henderson County Convenience Center
Henry	y	Henry County Recycling/Convenience Center
Hickman	y	Hickman County Recycling Program
Houston	y	Houston County Convenience Center
Jackson	y	Jackson County Recycling Center
Jefferson	y	Jefferson County Recycle Facility
Lawrence	y	Lawrence County Solid Waste (sorting)
Lewis	y	Lewis County Solid Waste
Lincoln	y	Keep Fayetteville-Lincoln County Beautiful
Loudon	y	Lenoir City Convenience Center
Marshall	y	Marshall County Solid Waste (sorting)
Maury	y	Maury County Solid Waste
Montgomery	y	Bi-County Solid Waste Management System
Moore	y	Moore County Convention Center
Morgan	y	Recycling Center
Obion	y	Obion County
Overton	y	Livingston Recycle Center
Perry	y	Perry County Transfer
Pickett	y	Pickett County Recycling Center
Putnam	y	Putnam County Recycling Center/Transfer Station
Roane	y	Roane County Recycling Center (sorting)
Robertson	y	Robertson County Transfer Station



Scott	y	Scott County Recycling Center
Sevier	y	Sevier Solid Waste, Inc.
Smith	y	North Central Recycling (sorting)
Sullivan	y	Sullivan County Solid Waste Department
Union	y	Wolfe Road Convenience Center
Van Buren	y	Van Buren Recycling Center
Warren	y	Coffee County Recycling Center
Washington	y	Washington County Materials Processing Facility
Wayne	y	Wayne County Solid Recycling Facility
Williamson	y	Republic Allied Waste / Williamson County (MRF)
Blount	n	Spectra Recycling
Davidson	n	Waste Management River Hills Recycling (MRF)
Hamblen	n	Goodwill Industries (MRF)
Hamilton	n	John F. Germ Recycling Center at Orange Grove (MRF)
Hamilton	n	RockTenn Chattanooga (MRF)
Humphreys	n	James Development Center (baling w/sort)
Johnson	n	Tri-City Waste Paper (baling w/ sort)
Knox	n	SP Recycling
Knox	n	Tennessee American Recycling
Knox	n	RockTenn Knoxville (MRF)
Madison	n	Southeast Recycled Fiber LLC
Monroe	n	Advanced Polymer Recycling
Shelby	n	Memphis Recycling Service (baling w/ sort)
Shelby	n	RockTenn Memphis (MRF)
Shelby	n	International Paper
Shelby	n	ReCommunity Memphis (MRF)
Sumner	n	Waste Management Rivergate Recycling (MRF)
Weakley	n	UTM Recycles
White	n	M & M Recycling
Wilson	n	SP Recycling
Wilson	n	RockTenn Nashville (Baling w/ sort)

